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SHORT REPORT

Intraoperative Duplex Ultrasound Assisted Management of Complex Endoleak

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Abstract Accurate detection and categorization of endoleaks in failing endografts is crucial in determining their management. The most commonly used imaging modalities are not always definitive. We report a patient with complex mixed endoleaks in whom intraoperative ultrasound resolved diagnostic uncertainty and provided immediate on table confirmation of endoleak exclusion.

Introduction

Postoperative endoleak continues to be a frequent complication which limits the success of aortic stent-graft repair. Whilst many type 2 endoleaks are now managed conservatively, intervention may be warranted in the presence of progressive sac expansion. Persistent attachment site (type 1) and junctional zone (type 3) endoleaks are more strongly associated with aneurysm rupture and usually require re-intervention.[1]

In patients with endoleak undergoing surgical conversion there is frequently a history of unsuccessful re-interventions and these patients often have more than one endoleak or endoleak associated with graft migration. Accurate characterisation of all endoleaks is vital in determining subsequent treatment. The most frequently employed imaging modalities of Computed Tomography (CT) and angiography, add to the already considerable radiation burden of these patients and require the use of potentially nephrotoxic contrast media.

Whilst CT angiography is considered the current gold standard, it is becoming clear that this does not accurately detect all endoleaks and in most institutions this modality cannot be employed intraoperatively. Intraoperative angiography is necessary for re-interventions but sensitivity may be diminished by patient obesity and other factors. There are also variations in performance between high quality fixed endovascular imaging suite fluoroscopy units and portable image intensifiers.

Although intraoperative duplex ultrasound (IODUS) has been successfully described in carotid, lower limb, and visceral revascularization its use in characterising and managing re-interventions following EVAR is infrequent.

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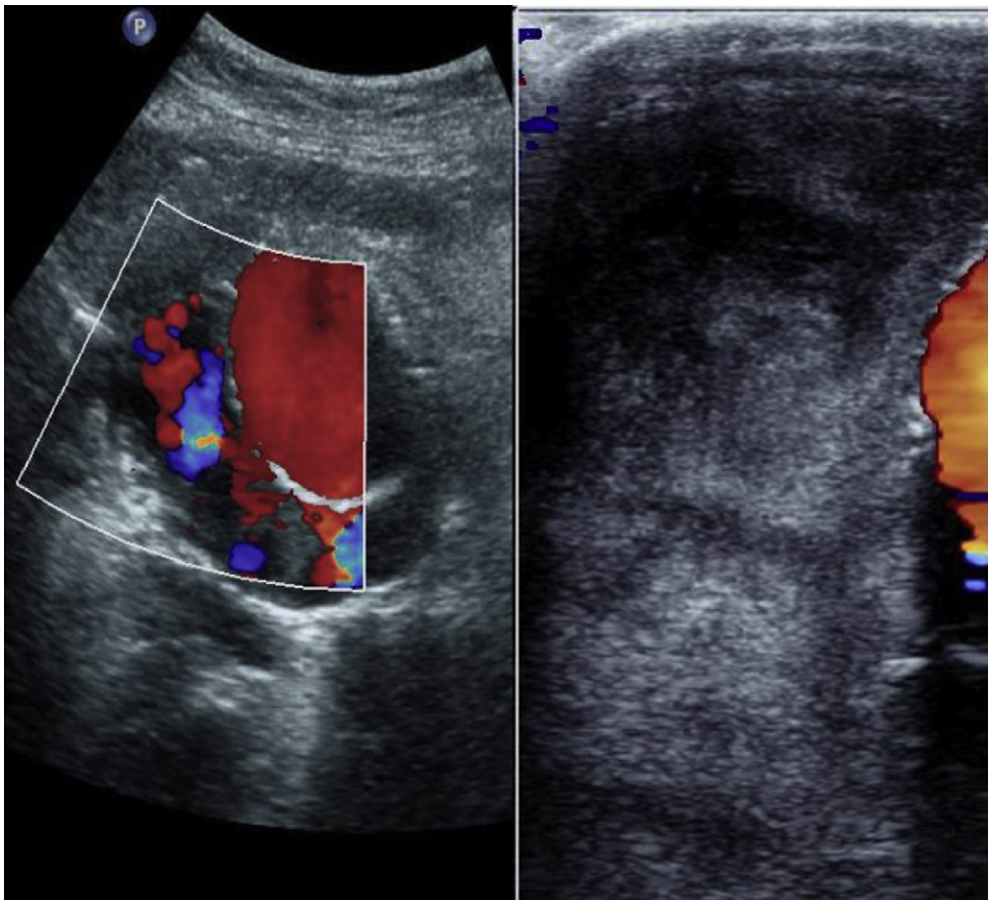

Figure 1 Left-Pre-operative ultrasound view demonstrating colour flow within the aneurysm sac. Right-Intraoperative duplex ultrasound: transverse view of superior aspect of aneurysm sac (linear 7—4 MHz transducer placed directly onto the anterior aortic surface) performed 10 min after aortic neck banding showing proximal cavities in the right lateral aspect of the aortic aneurysm sac that have sealed (centrally anechoic with no flow seen and hyperechoic rims, consistent with recent thrombosis).

Report

An 84 year old female with a history of TIAs, hypertension, renal impairment, underwent EVAR (Zenith® aortic stent, Cook, Bloomington, Indiana) for a 68 mm diameter infra-renal aneurysm. Post-procedural surveillance with CTA and Duplex ultrasound identified a persistent type 2 endoleak with 4 mm sac expansion and a probable feeding lumbar artery.

Right ilio-lumbar artery embolisation performed 19 months post-operatively, appeared to have occluded the feeding lumbar artery however subsequent CT and duplex ultrasound showed a persistent type 2 endoleak and the latter suggested a type 1a endoleak.

Aortic stent graft balloon moulding with surgical access from the right groin was performed two months later. Preliminary angiography confirmed a type 1 endoleak arising from the top of stent graft and the suprarenal fixation was moulded with a Coda balloon® (Cook, Bloomington, Indiana). Despite this, there was a persistent type 1 endoleak at the end of the procedure. We opted not to place an uncovered stent proximally as there was a short focal 4 cm dilatation of the immediately suprarenal aorta making the anatomy unfavourable.

CTA one month later, showed persistent proximal type 1 endoleak, with a further distal endoleak which we could not confidently characterise. There was further significant sac expansion (overall sac expansion post EVAR 9 mm). A decision was made to proceed to open banding of the stent graft for the type 1 endoleak and also to ligate the branches causing the presumed type 2 endoleak. This was performed a few days later.

The stent graft was banded with tape around the aneurysm neck and the IODUS (Fig. 1) and angiography confirmed type 1 endoleak resolution. As angiography was unhelpful in identifying the distal endoleak, IODUS (Philips® IU 22 machine with sterile gel and an extended sterile probe cover) was then used to guide ligation of the retro-aortic vessels responsible for the type 2 endoleak at the aortic bifurcation (Fig. 2). Two vessels (presumed lumbar arteries) were tied surgically after encircling the distal aorta and iliac arteries. The repeat IODUS showed absence of all leaks (Fig. 2). We had considered that these lumbar vessels may have been acting as outflow for the type 1a endoleak but bi-directional flow persisted following banding and we felt this indicated an additional type 2 endoleak and therefore surgical ligation was performed.

Post-operatively there was bleeding from the arteriotomy site used for angiography and emergency laparotomy was performed in which a lateral suture on left external iliac artery stopped the bleeding. Despite this she died 3 days later from multi-organ failure.

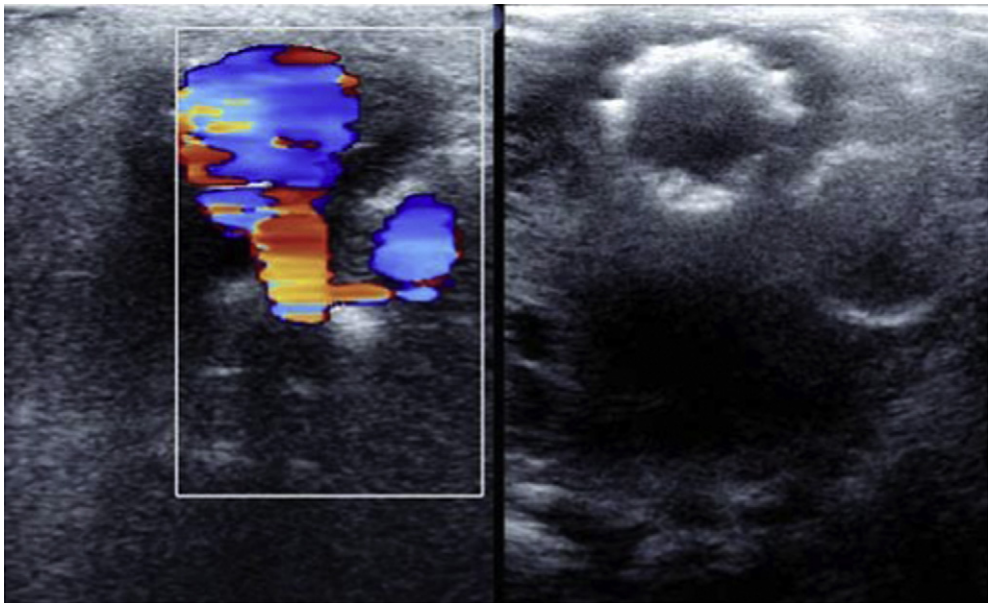

Figure 2 Intraoperative duplex ultrasound: transverse view overlying right sided common iliac artery distal fixation site (linear 7—4 MHz transducer placed directly onto the anterior aortic surface). The right lateral aspect of the sac shows active, bi-directional flow just posterior to the right limb. In the distal margin of the sac there is a 5 mm posterior lumbar vessel with flow entering the aortic sac. Following further dissection and ligation of this lumbar vessel, successful exclusion of flow from the sac with thrombosis of the previously active flow cavities and absence of the previously seen lumbar vessel.

Discussion

Despite meticulous examination technique, accurate diagnosis of all post EVAR endoleaks is not currently possible. In the presence of sac expansion most units would advocate re-intervention to minimise the risk of rupture.

In our case there was considerable diagnostic uncertainty in the face of an evolving pattern of endoleaks within a failing graft. Open conversion of failing stent grafts is a rare event. In the largest series[2] only 25 out of 1600 (1.6%) required surgical explantation. Many had undergone unsuccessful attempts at endovascular salvage and graft explantation carried a 19% mortality rate. Explanted patients often had multiple indications or more than one endoleak.

Type 1 and type 3 endoleaks were the most significant risk factors with aneurysm growth present in most patients, although type 2 endoleak was also present in 22% of patients. This contrasts with the EUROSTAR registry experience of a single case of type 2 endoleak in 34 patients with confirmed aneurysm rupture post EVAR.[1]

There is little data to suggest sac expansion thresholds that may reliably predict the need for re-intervention or open surgical conversion. Assessment of inter-observer variability in CT assessment of maximum aneurysm diameter ranges from 2 mm to 5 mm or greater[3,4] so any clinically useful threshold is likely to be greater than 5 mm.

In our patient ultimately, IODUS provided definitive characterisation of both endoleaks and allowed immediate confirmation that they had been completely abolished.

IODUS has proven useful in carotid,[5] lower limb,[6] and visceral arterial[7] surgery and we feel that it is a useful adjunct in the surgical management of patients with failing aortic stent grafts. The technique is rapid, accurate and requires minimal additional resources for most units. It also carries the potential to reduce radiation and nephrotoxic contrast media usage.

Conflict of Interest

None.

Funding

None.

References

1 Fransen GAJ, Vallabhaneni SR, Van Marrewijk CJ, Laheij RJF, Harris PL, Buth J. On behalf of EUROSTAR collaborators. Rupture of infra-renal aortic aneurysm after endovascular repair: a series from EUROSTAR registry. *Eur J Vasc Endovasc Surg* 2003;**26**: 487—93.

2 Kelso RL, Lyden SP, Butler B, Greenberg RK, Eagleton MJ, Clair DG. Late conversion of aortic stent grafts. *J Vasc Surg* 2009; **49**:589—95.

3 Lederle FA, Wilson SE, Johnson GR, Reinke DB, Littooy FN, Acher CW, et al. Variability in measurement of abdominal aortic aneurysms. *J Vasc Surg* 1995;**21**:945—52.

4 Aarts NJ, Schurink GW, Schultze Kool LJ, Bode PJ, van Baalen JM, Hermans J, et al. Abdominal aortic aneurysm measurements for endovascular repair: intra- and interobserver variability of CT measurements. *Eur J Vasc Endovasc Surg* 1999; **18**:475—80.

5 Mullenix PS, Tollefson DFJ, Olsen SB, Hadro NC, Andersen CA. Intraoperative duplex ultrasonography as an adjunct to technical excellence in 100 consecutive carotid endarterectomise. *Am J Surg* 2003;**185**:445—9.
6 Cull DL, Gregory RT, Wheeler JR, Snyder SO, Gayle RG, Parent III FN. Duplex scanning for the intraoperative assessment of infrainguinal arterial reconstruction: a useful tool? *Ann Vasc Surg* 1992;**6**:20—4.
7 Oderich GS, Panneton JM, Macedo TA, Noel AA, et al. Intraoperative duplex ultrasound of visceral revascularizations: optimizing technical success and outcome. *J Vasc Surg* 2003;**38**: 684—91.